

APPENDIX C.7

DESCRIPTION OF INPUT AND FINAL WASTE STREAMS

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C.7 Description of Input and Final Waste Streams

The alternatives analyzed in this EIS were designed to offer a full range of options for treating the high-level waste (HLW) and sodium-bearing waste (SBW) presently stored by DOE at the Idaho Nuclear Technology and Engineering Center (INTEC). Each option would begin with essentially the same input streams (i.e., the inventory of HLW and SBW). In addition, ongoing INTEC operations would generate new radioactive liquid wastes from decontamination activities. Ultimately, each option would result in a final waste stream suitable for disposal. For each option, the final waste stream would consist of one or more forms (i.e., borosilicate glass, Class A grout, etc.). Each of these forms would be designed to meet the waste acceptance criteria set by the intended disposal facility (i.e., the Waste Isolation Pilot Plant, geologic repository, etc.). Table C.7-1 lists existing and projected input waste streams and quantities. Table C.7-2 through C.7-5 list the concentrations of chemical and radioactive constituents in the calcine and SBW. The values provided in Tables C.7-2 through C.7-5 have been estimated by a variety of methods, and not all constituents have been verified by sampling and analysis. Table C.7-6 lists output waste streams for each option. The table includes the output compositions, quantities, numbers of containers, and final dispositions. Table C.7-6 only includes those wastes designated as “product waste” as defined in Section 5.2.13. Other waste generated indirectly as a result of the activities under the waste processing alternatives (“process wastes”) are described in Section 5.2.13. References are provided for the data in all tables.

Table C.7-1. Waste processing alternative inputs.

Waste (type)	Quantity	Source
Calcine – granular solid (mixed HLW)	4,155 m ³ ^(a) 5,435 m ³ ^(b)	Staiger (1999) Russell et al. (1998)
SBW – acid solution (mixed transuranic waste)	~800,000 gallons	Russell et al. (1998)
Concentrated NGLW (Type 1) – acid solution (mixed transuranic waste)	~300,000 gallons ^c (1998-2016)	Russell et al. (1998) Barnes (1999) McDonald (1998)
Other NGLW (Type 2) – acid solution (mixed low-level waste)	~230,000 gallons ^c (1998-2032)	Russell et al. (1998) Barnes (1999) McDonald (1998)

a. Without SBW/NGLW calcination.

b. With SBW/NGLW calcination.

c. The volume of these wastes may be reduced or eliminated by actions taken under the INEEL liquid waste management program.

NGLW = newly generated liquid waste; m³ = cubic meters; ~ = approximately.

Table C.7-2. Bin set total chemical inventory (kilograms).^a

Constituent	Bin set 1	Bin set 2	Bin set 3	Bin set 4	Bin set 5	Bin set 6	Total mass (kg)	Average concentration (kg/m ³)
Al	8.70×10^4	2.66×10^5	1.56×10^5	7.08×10^4	1.52×10^5	2.41×10^5	9.74×10^5	234
B	452	6.02×10^3	1.15×10^4	6.58×10^3	1.23×10^4	3.97×10^3	4.08×10^4	9.81
Ca	0	1.85×10^5	3.54×10^5	2.06×10^5	3.41×10^5	6.22×10^4	1.15×10^6	276
Cd	0	0	0	0	4.07×10^4	6.07×10^3	4.68×10^4	11.3
Cr	0	1.50×10^3	2.88×10^3	1.78×10^3	1.74×10^3	1.07×10^3	8.97×10^3	2.16
Fe	1.54×10^3	1.30×10^3	3.21×10^3	4.41×10^3	7.23×10^3	5.25×10^3	2.29×10^4	5.52
Cs	55.9	129	123	86	149	41	584	0.14
Hg	3.43×10^3	127	27	12	28	28	3.65×10^3	0.88
K	0	1.38×10^3	2.75×10^3	3.28×10^3	9.23×10^3	1.15×10^4	2.81×10^4	6.76
Mg	0	5.37×10^3	8.79×10^3	1.72×10^3	6.36×10^3	4.60×10^3	2.68×10^4	6.46
Mn	0	0	363	0	285	583	1.23×10^3	0.30
Na	2.41×10^3	6.48×10^3	1.36×10^4	1.34×10^4	4.59×10^4	4.55×10^4	1.27×10^5	30.6
Nb	0	0	0	0	2.77×10^3	0	2.77×10^3	0.67
Ni	0	422	831	602	381	424	2.66×10^3	0.64
Sr	37.3	1.99×10^3	3.66×10^3	2.17×10^3	3.60×10^3	215	1.17×10^4	2.81
Sn	0	1.75×10^3	3.27×10^3	1.61×10^3	2.20×10^3	246	9.08×10^3	2.18
U	12.8	40	18	41	209	214	535	0.13
Zr	0	1.08×10^5	2.05×10^5	1.01×10^5	1.42×10^5	1.55×10^4	5.71×10^5	138
Br	0	0	546	805	1.90×10^3	1.43×10^3	4.69×10^3	1.13
F	0	1.61×10^5	2.89×10^5	1.45×10^5	2.26×10^5	2.80×10^4	8.48×10^5	204
CO ₃	0	2.65×10^4	4.29×10^4	8.48×10^3	3.07×10^4	2.27×10^4	1.31×10^5	31.6
NO ₃	4.28×10^3	1.30×10^4	2.72×10^4	2.74×10^4	9.16×10^4	8.93×10^4	2.53×10^5	60.9
PO ₄	1.96×10^3	3.28×10^3	1.35×10^4	532	2.51×10^3	2.35×10^3	2.42×10^4	5.82
SO ₄	2.94×10^3	5.14×10^3	6.97×10^3	871	2.79×10^4	8.83×10^3	5.27×10^4	12.7

a. Source : Staiger (1999).

Table C.7-3. Bin set total inventory of radionuclides decayed to 2016 (curies).^a

Constituent	Bin set 1	Bin set 2	Bin set 3	Bin set 4	Bin set 5	Bin set 6	Total activity (Ci)	Average concentration (Ci/m ³)
Ni-63	0	592	2.22×10 ³	1.62×10 ⁵	1.61×10 ³	376	1.67×10 ⁵	40.2
Sr-90	7.46×10 ⁵	2.09×10 ⁶	1.78×10 ⁶	1.31×10 ⁶	2.64×10 ⁶	6.80×10 ⁵	9.24×10 ⁶	2.22×10 ³
Y-90	7.46×10 ⁵	2.09×10 ⁶	1.78×10 ⁶	1.31×10 ⁶	2.64×10 ⁶	6.80×10 ⁵	9.24×10 ⁶	2.22×10 ³
Tc-99	419	881	736	479	861	216	3.59×10 ³	0.86
Sb-126	1.54	2.68	2.75	1.81	3.17	0.97	12.9	3.11×10 ⁻³
Sb-126m	11	23	20	13.1	23.1	7.46	97.6	0.02
Ba-137m	7.70×10 ⁵	1.87×10 ⁶	1.83×10 ⁶	1.17×10 ⁶	2.18×10 ⁶	6.07×10 ⁵	8.43×10 ⁶	2.03×10 ³
Cs-137	8.15×10 ⁵	1.98×10 ⁶	1.93×10 ⁶	1.24×10 ⁶	2.31×10 ⁶	6.38×10 ⁵	8.91×10 ⁶	2.14×10 ³
Th-231	0.02	0.09	0.25	0.10	0.61	3.36	4.43	1.07×10 ⁻³
Pa-233	1.16	2.11	1.87	0.20	2.83	21.7	29.8	7.18×10 ⁻³
Np-237	1.16	2.11	2.30	0.20	3.23	25.2	34.2	8.23×10 ⁻³
Pu-238	443	1.12×10 ⁴	2.47×10 ⁴	1.67×10 ⁴	2.81×10 ⁴	5.36×10 ³	8.65×10 ⁴	20.8
Pu-239	55.9	256	473	303	534	512	2.13×10 ³	0.51
Pu-240	22.4	189	401	274	445	129	1.46×10 ³	0.35
Pu-241	196	5.19×10 ³	8.10×10 ³	4.76×10 ³	1.08×10 ⁴	2.32×10 ³	3.13×10 ⁴	7.54
Am-241	126	1.38×10 ³	2.22×10 ³	1.36×10 ³	2.81×10 ³	749	8.65×10 ³	2.08

a. Source : Staiger (1999).

Table C.7-4. Calculated radionuclide activities for SBW (curies per liter) (decayed to 2016).^a

Radionuclide	Radionuclide	Radionuclide			
Hydrogen 3	6.6×10^{-6}	Samarium 148	4.7×10^{-17}	Thorium 228	2.4×10^{-9}
Beryllium 10	3.7×10^{-12}	Samarium 149	4.2×10^{-18}	Thorium 229	4.8×10^{-13}
Carbon 14	1.5×10^{-10}	Europium 150	1.4×10^{-11}	Thorium 230	1.1×10^{-9}
Cobalt 60	8.1×10^{-6}	Samarium 151	3.8×10^{-4}	Thorium 231	2.6×10^{-8}
Nickel 63	3.5×10^{-5}	Europium 152	1.6×10^{-6}	Thorium 232	9.0×10^{-16}
Selenium 79	5.4×10^{-7}	Gadolinium 152	1.8×10^{-18}	Thorium 234	2.6×10^{-8}
Rubidium 87	3.6×10^{-11}	Europium 154	7.0×10^{-5}	Protactinium 231	1.2×10^{-10}
Strontium 90	0.047	Europium 155	3.3×10^{-5}	Protactinium 233	3.6×10^{-6}
Yttrium 90	0.047	Holmium 166m	5.7×10^{-11}	Protactinium 234m	2.6×10^{-8}
Zirconium 93	2.7×10^{-6}	Thulium 171	5.7×10^{-18}	Protactinium 234	3.3×10^{-11}
Niobium 93m	2.3×10^{-6}	Thallium 207	7.0×10^{-11}	Uranium 232	2.3×10^{-9}
Niobium 94	1.4×10^{-6}	Thallium 208	8.5×10^{-10}	Uranium 233	3.0×10^{-10}
Technetium 98	3.2×10^{-12}	Thallium 209	1.0×10^{-14}	Uranium 234	1.0×10^{-6}
Technetium 99	1.2×10^{-5}	Lead 209	4.8×10^{-13}	Uranium 235	2.6×10^{-8}
Rhodium 102	4.8×10^{-11}	Lead 210	6.7×10^{-12}	Uranium 236	4.1×10^{-8}
Ruthenium 106	1.5×10^{-10}	Lead 212	2.4×10^{-9}	Uranium 238	2.6×10^{-8}
Rhodium 106	1.5×10^{-10}	Lead 211	7.0×10^{-11}	Uranium 237	4.3×10^{-9}
Palladium 107	2.0×10^{-8}	Lead 214	1.6×10^{-11}	Uranium 240	8.4×10^{-16}
Silver 108m	4.9×10^{-13}	Bismuth 210m	2.7×10^{-25}	Neptunium 237	3.6×10^{-6}
Cadmium 113m	2.2×10^{-6}	Bismuth 210	6.7×10^{-12}	Neptunium 238	8.9×10^{-11}
Indium 115	1.2×10^{-16}	Bismuth 211	7.0×10^{-11}	Neptunium 239	2.6×10^{-8}
Tin 121m	6.9×10^{-8}	Bismuth 212	2.4×10^{-9}	Plutonium 236	1.4×10^{-10}
Tellurium 123	4.7×10^{-19}	Bismuth 213	4.8×10^{-13}	Plutonium 238	4.2×10^{-4}
Antimony 125	6.2×10^{-7}	Bismuth 214	1.6×10^{-11}	Plutonium 239	6.7×10^{-5}
Tellurium 125m	1.5×10^{-7}	Polonium 210	6.7×10^{-12}	Plutonium 240	1.3×10^{-5}
Tin 126	5.1×10^{-7}	Polonium 212	1.5×10^{-9}	Plutonium 241	1.7×10^{-4}
Antimony 126	7.1×10^{-8}	Polonium 216	2.4×10^{-9}	Plutonium 242	9.8×10^{-9}
Antimony 126m	5.1×10^{-7}	Polonium 218	1.6×10^{-11}	Plutonium 244	8.4×10^{-16}
Iodine 129	1.0×10^{-5}	Astatine 217	4.8×10^{-13}	Americium 241	6.6×10^{-5}
Cesium 134	3.3×10^{-7}	Radon 219	7.0×10^{-11}	Americium 242m	1.8×10^{-8}
Cesium 135	1.1×10^{-6}	Radon 220	2.4×10^{-9}	Americium 242	1.8×10^{-8}
Cesium 137	0.046	Radon 222	1.6×10^{-11}	Americium 243	2.6×10^{-8}
Barium 137m	0.044	Francium 221	4.8×10^{-13}	Curium 242	1.5×10^{-8}
Lanthanum 138	2.4×10^{-16}	Francium 223	9.7×10^{-13}	Curium 243	2.6×10^{-8}
Cerium 142	3.7×10^{-11}	Radium 223	7.0×10^{-11}	Curium 244	1.3×10^{-6}
Cerium 144	7.3×10^{-12}	Radium 224	2.4×10^{-9}	Curium 245	3.7×10^{-10}
Praseodymium 144	7.3×10^{-12}	Radium 225	4.8×10^{-13}	Curium 246	2.4×10^{-11}
Praseodymium 144m	8.7×10^{-14}	Radium 226	1.6×10^{-11}	Curium 247	2.7×10^{-17}
Neodymium 144	2.0×10^{-15}	Radium 228	8.3×10^{-16}	Curium 248	2.9×10^{-17}
Promethium 146	1.2×10^{-8}	Actinium 225	4.8×10^{-13}	Californium 249	2.1×10^{-17}
Samarium 146	3.4×10^{-13}	Actinium 227	7.0×10^{-11}	Californium 250	8.8×10^{-18}
Promethium 147	6.8×10^{-6}	Actinium 228	8.3×10^{-16}	Californium 251	3.3×10^{-19}
Samarium 147	9.1×10^{-12}	Thorium 227	6.9×10^{-11}		

a. Source: Wenzel (1997).

Table C.7-5. Concentration of fission product chemical elements in SBW (decayed to 2016) (g/L).^a

Element	Element
Lithium	3.5×10^{-10}
Beryllium	1.9×10^{-10}
Gallium	1.7×10^{-12}
Germanium	8.2×10^{-7}
Arsenic	2.3×10^{-7}
Selenium	8.1×10^{-5}
Bromine	3.1×10^{-5}
Rubidium	6.1×10^{-4}
Strontium	9.3×10^{-4}
Yttrium	7.8×10^{-4}
Zirconium	4.8×10^{-3}
Molybdenum	4.4×10^{-3}
Niobium	7.5×10^{-6}
Technetium	7.3×10^{-4}
Ruthenium	2.2×10^{-3}
Rhodium	4.8×10^{-4}
Palladium	4.8×10^{-4}
Silver	8.8×10^{-6}
Cadmium	2.6×10^{-5}
Indium	2.0×10^{-6}
Tin	5.0×10^{-5}
Antimony	1.0×10^{-5}
Tellurium	4.7×10^{-4}
Iodine	0.058
Cesium	3.0×10^{-3}
Barium	2.9×10^{-3}
Lanthanum	1.6×10^{-3}
Cerium	3.2×10^{-3}
Praseodymium	1.5×10^{-3}
Neodymium	5.5×10^{-3}
Promethium	7.3×10^{-9}
Samarium	1.1×10^{-3}
Europium	9.9×10^{-5}
Gadolinium	5.2×10^{-5}
Terbium	4.3×10^{-7}
Dysprosium	1.3×10^{-7}
Holmium	5.6×10^{-9}
Erbium	2.2×10^{-9}
Thulium	1.1×10^{-12}
Ytterbium	1.9×10^{-13}
Thallium	1.3×10^{-17}
Lead	1.9×10^{-10}
Bismuth	3.8×10^{-15}
Polonium	1.5×10^{-15}
Astatine	1.5×10^{-25}
Francium	2.4×10^{-20}
Radium	1.6×10^{-11}
Actinium	8.9×10^{-13}
Thorium	6.4×10^{-8}
Protactinium	2.2×10^{-9}
Uranium	0.089
Neptunium	5.3×10^{-5}
Plutonium	1.2×10^{-3}
Americium	1.9×10^{-5}
Curium	1.9×10^{-8}
Californium	5.4×10^{-18}

a. Source: Wenzel (1998).

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